

CLAIMS

5/13 B

1. Radiofrequency transmitter, of the type supplied with two signals in baseband and in quadrature, $i(nT)$ and $q(nT)$, which are images from two binary streams representing information to be transmitted, the 5 radiofrequency transmitter characterized in that it comprises:
 - means (1) of transposition into an intermediate frequency and of digital processing, that provide a first transposition into the digital domain, at an 10 intermediate frequency ω_0 , for said base band signals, and generating, by combination, two signals at the intermediate frequency and in quadrature;
 - means (2) of direct conversion, providing a second transposition into the analog domain, after 15 multiplication by a frequency ω_1 , followed by a summation, of said two signals at the intermediate frequency and in quadrature, in a way that generates a resultant signal which is finally modulated around a frequency ω_2 , where $\omega_2 = \omega_0 + \omega_1$.

2. Radiofrequency transmitter according to Claim 1, characterized in that said two signals at the intermediate frequency and in quadrature are of the form:

5 * $m_1(t) = i(t) \cdot \cos(\omega_0 t) - q(t) \cdot \sin(\omega_0 t)$

 * $m_2(t) = -i(t) \cdot \sin(\omega_0 t) - q(t) \cdot \cos(\omega_0 t)$

and in that said resultant signal is of the form

 * $m(t) = g_1 \cdot m_1(t) \cdot \cos(\omega_1 t + \theta_1) + g_2 \cdot m_2(t) \cdot \sin(\omega_1 t + \theta_2)$

where

10 - g_1 and g_2 are the respective gains for the two channels in quadrature of said means of direct conversion

15 - θ_1 and θ_2 are the respective phase shifts for the two channels in quadrature of said means of direct conversion.

a 5 Sub B' > 3. Radiofrequency transmitter according to *any one of Claims 1 and 2* characterized in that it is produced in the form of an integrated circuit.

a 4. Radiofrequency transmitter according to *any one of Claims 1 to 3* characterized in that it additionally comprises filtering means (17) that receive and filter said resultant signal, in a way that suppresses, at least in part, a parasitic component of said resultant signal, at the image frequency ω_2 of said frequency ω_2 .

a 25 5. Radiofrequency transmitter according to *Claims 1 and 4*, characterized in that, at least a part of said filtering means (17) is included in said integrated circuit.

Q 6. Radiofrequency transmitter according to ~~any one~~^{claim 1}
~~a of Claims 1 to 5~~, characterized in that it additionally
 comprises means (10, 11) of digitally compensating for
 imperfections in gain and in phase of said means of
 5 direct conversion.

5/1B 7. Radiofrequency transmitter according to Claim 6,
 characterized in that, said means of digital
 compensation comprise:

- means (10) of estimating the imperfections in gain Δg
 10 and in phase $\Delta\theta$ of said means of direct conversion
 with,

$$* \Delta g = g_2 - g_1$$

$$* \Delta\theta = \theta_2 - \theta_1$$

- means (11) of applying a correction to said two
 15 signals at the intermediate frequency and in
 quadrature, in a way that generates two corrected
 signals, $m_{1c}(t)$ and $m_{2c}(t)$ at the intermediate
 frequency and in quadrature, the corresponding
 resultant corrected signal being written:

$$20 * m_c(t) = g_1 \cdot m_{1c}(t) \cdot \cos(\omega_1 t + \theta_1) + g_2 \cdot m_{2c}(t) \cdot \sin(\omega_1 t + \theta_2)$$

8. Radiofrequency transmitter according to Claim 7,
 characterized in that, said means (10) of estimating
 imperfections comprise:

- transposition means (12), that provide a third
 25 transposition in the analog domain, by multiplication of
 the resultant signal by said transmission frequency ω_1 ,
 in a way that generates the following intermediate
 signal :

$$* m'_3(t) = g_3 \cdot m(t) \cdot \cos(\omega_1 t + \theta_1),$$

where g_3 is the gain introduced by said transposition means (12), said filtering means (13) and said analog/digital A/N conversion means (14).

- high stop filtering means (13), providing
- 5 filtration of the intermediate signal and generating an intermediate filtered signal $m'(t)$;
- analog/digital conversion means (14), enabling one to convert the intermediate filtered signal $m'(t)$ into digital;
- 10 - means (15) of calculating imperfections in gain Δg and in phase $\Delta\theta$ from the digital filtered intermediate signal by said means of analog/digital conversion.

9. Radiofrequency transmitter according to Claim 8, 15 characterized in that, said means (15) of calculating imperfections in gain Δg and in phase $\Delta\theta$ comprise:

- means of transforming said digital filtered intermediate signal in the form:

$$* m'(t) = I'(t) \cdot \cos(\omega_0 t) - q'(t) \cdot \sin(\omega_0 t)$$

20 and in that the imperfections in gain Δg and in phase $\Delta\theta$ are estimated in accordance with the following formulae;

$$* \Delta g = 2g - (4/g_3) \cdot [I'(t) + q'(t)] \cdot [i(t) - q(t)]$$

$$* \Delta\theta = (1/g \cdot g_3) \cdot [i(t) \cdot q'(t) - q(t) \cdot i'(t)].$$

a 10. Radiofrequency transmitter according to ^{Claim 8} ~~any one~~ of ~~Claims 8 and 9~~, characterized in that said gains g and g_3 have values of power 2.

a 11. Radiofrequency transmitter according to ^{Claim 7} ~~any one~~ of ~~Claims 7 to 10~~, characterized in that said two corrected signals, at the intermediate frequency and in

quadrature, are written in the following simplified form:

$$* m_{1c}(t) = (1 + (\Delta g / 2g)) \cdot [i(t) \cdot \cos(\omega_0 t - (\Delta\theta / 2)) - q(t) \cdot \sin(\omega_0 t - (\Delta\theta / 2))]$$

$$* m_{2c}(t) = -(1 - (\Delta g / 2g)) \cdot [i(t) \cdot \sin(\omega_0 t + (\Delta\theta / 2)) - q(t) \cdot \cos(\omega_0 t + (\Delta\theta / 2))]$$

5 *Q* 12. Radiofrequency transmitter according to ~~any one~~^{Claim b}
6 *Q* of ~~Claims 6 to 11~~, characterized in that said means (14)
7 of analog/digital conversion have a working frequency
8 substantially identical to the working frequency of
9 means (5₁, 5₂) of digital/analog conversion included in
10 said means (2) of direct conversion.

11 *a* 13. Radiofrequency transmitter according to Claim 3
12 and ~~any one of Claims 6 to 12~~, characterized in that
13 said means (10, 11) of digital compensation are included
14 in said integrated circuit.